Explicit Modeling of Convection in the Terminal Area

In the process of calculating statistics for the 6 selected cases, several issues have arisen in regard to how reflectivity is represented by the NIDS level-III data versus how reflectivity is derived from the model data. For example, NIDS observations of zero or very low dBZ are coded the same as true null reports. Since the verification program does not consider columns with null reports when calculating statistics, all areas with no storms observed were originally excluded from the calculations regardless of whether or not the model created storms in the same area. This incorrectly reduced the False Alarm Rate (FAR) and increased the Critical Success Index (CSI). To ameliorate this problem, all null reports are now simply interpreted as zero dBZ, and are only reset to "missing" if there is a high variance in the observations around an ARPS grid point. Although there was only a slight degradation of FAR scores for the case that we have been working with, we anticipate a substantial difference for cases in which the ARPS model overestimated the convective coverage area, including cases that will be considered in the coming weeks.

A consideration was given to how the radius was defined in the fuzzy logic code, which determines the acceptable range of separation between a forecast and an observed storm for a forecast to be considered a "hit". Previously, the verification program allowed for a separation based on a set number of cells, which were assumed to be 4km x 4km in size (as in Hallowell et al. 1999). However, the ARPS forecasts used in this study are of grid resolution 3km. Instead of defining separation by number of cells (which varies by grid resolution), the verification program was changed to calculate physical separation point to point. A set radius of separation can now be defined without reference to data spatial resolution.

A final major issue stems from the limit in vertical coverage of the NIDS data, which provides data only from the first 4 radar tilts. Thus, in determining the maximum reflectivity that occurs for a column above any point, only a fraction of a storm's reflectivity is available in the NIDS data. (The vertical extent of reflectivity represented in the NIDS data is dependent on the tilt of the radar beam above a given point and thus dependent inately on the distance from the radar location.) In contrast, reflectivity from the model data can be derived for the entire column. In order to make a more direct comparison, it is important that the reflectivity maxima of the observations and the model are obtained from the same vertical window for each column as determined by the limit in range of the NIDS data. Otherwise, the model could register higher reflectivities over more points in the domain, which would inflate FAR and incorrectly reduce Probability of Detection (POD) and CSI.

The verification program has been corrected such that reflectivity maxima are defined by searching the same vertical extent in both the NIDS and model data for a given column. The effect can be seen in Figure 1, which shows the results of the 6-hour forecast. The amount of reflectivity region for values less than 25 dBZ are reduced considerably in the model data. However, the areas of relatively high reflectivity (>45 dBZ) remain nearly the same. For this case, the POD and FAR, which only consider reflectivity > 41 dBZ, do not greatly change. This is true for nearly all hours of the forecast when comparing Tables 1 and 2 for this case.

It should be noted that the primary cause of forecast discrepancy is again primarily due to time/space lag errors. This is verified in Fig. 2 and Table 3 that shows dramatic improvement in the scores after the phase error has been minimized (using a phase shifting technique as described in the previous report).

As can be seen above, considerable amount of care was taken over the past month such that the inate limitations of the NIDS data have been identified and accounted for. This provides a clearer understanding of what the forecast verification is considering when comparing model forecast to radar observations and a clearer basis for interpreting the trends in the statistics over the 6-hour forecast. We are in a good position in the next few weeks to consider the remaining cases.

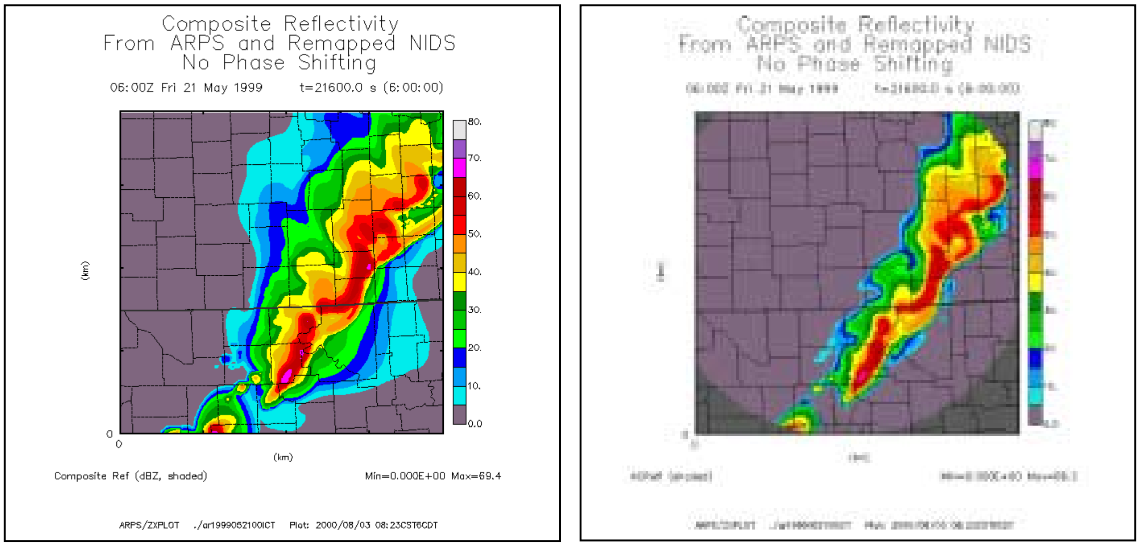

Figure 1. ARPS composite reflectivity (dBZ) defined by maximum over the entire height of a given column (left) , and over only the vertical window of a column as defined by the vertical physical extent of available NIDS data (right).

	POD	FAR	CSI
0-hr	0.963	0.000	0.963
1-hr	0.751	0.629	0.330
2-hr	0.508	0.780	0.181
3-hr	0.679	0.742	0.230
4-hr	0.757	0.670	0.299
5-hr	0.767	0.611	0.348
6-hr	0.781	0.743	0.240

Table 1: ARPS scores for 21 May 1999
Composite Reflectivity Threshold: 41 dBZ
Fuzzy Validation Without Phase Shifting
Radius: 5 nm (9.25 km)

	POD	FAR	CSI
0-hr	0.764	0.000	0.764
1-hr	0.501	0.673	0.246
2-hr	0.273	0.841	0.112
3-hr	0.593	0.695	0.252
4-hr	0.699	0.608	0.334
5-hr	0.641	0.589	0.334
6-hr	0.648	0.760	0.212

Table 2: ARPS scores for 21 May 1999
Composite Reflectivity Threshold: 41 dBZ
Fuzzy Validation Without Phase Shifting
Radius: 5 nm (9.25 km)
NIDS non-numeric data set to 0 dBZ
Composite Reflectivity Calculated Using Only Grid Points Matched with Observations

	POD	FAR	CSI
0-hr	0.586	0.000	0.586
1-hr	0.716	0.515	0.407
2-hr	0.876	0.377	0.573
3-hr	0.885	0.443	0.520
4-hr	0.883	0.370	0.582
5-hr	0.893	0.415	0.547
6-hr	0.883	0.587	0.392

Table 3: ARPS scores for 21 May 1999
Composite Reflectivity Threshold: 41 dBZ
Fuzzy Validation With Phase Shifting
Radius: 5 nm (9.25 km)
NIDS non-numeric data set to 0 dBZ
Composite Reflectivity Calculated Using Only Grid Points Matched with Observations

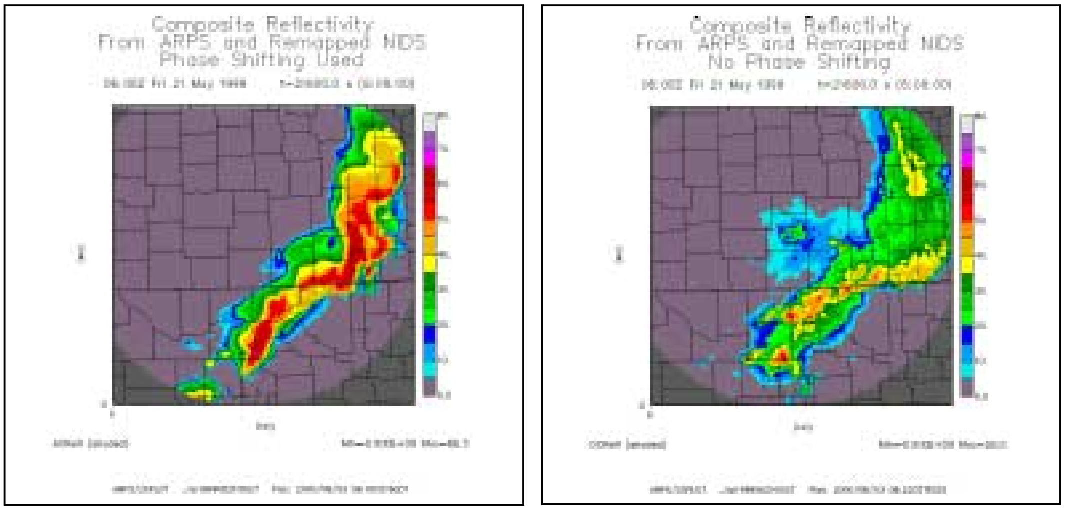

Figure 2. ARPS composite reflectivity as in Fig. 1 but after phase shifting (left) and NIDS radar reflectivity at the 6-hour forecast validation time.